REMARKS

Claims 1-28 were rejected under 35 U.S.C. § 103 as being unpatentable over FIES et al., in view of SCHOEN et al.

Prior to specifically addressing the Examiner's rejection, Applicant wishes to summarize the inventive concepts of the present invention, in order to best lay the foundation for traversal of the Examiner's rejection.

Summary of the Development of the Invention

The invention relates to the long-standing and common problem of precursor faults in quadrupole mass filters. Up until the development of the present invention, precursor faults were generally not understood and the cause of precursor faults remained a mystery. The prior preferred remedial action with respect to a precursor fault was to strip, clean and rebuild a QMF. However, this is time consuming, expensive, requires precision engineering and there is no guarantee of success.

Whilst researching the problem of precursor faults, the Inventors discovered, to their surprise, that precursor faults are caused by an asymmetric electric field within the central void of a QMF and specifically by an asymmetric electric field in the y-axis. It was further discovered that the asymmetry within the electric field is caused by the mechanical misalignment of one or both of the y-axis electrode rods and/or a surface charge imbalance between the electrode rods in the y-axis.

During the research project, the Inventors developed a method and means to check for a precursor fault and determine the filtering action of a QMF.

The Inventors also discovered a solution to the problem of precursor faults. It was found that an AC potential difference across the electrode rods in the y-axis has a corrective

effect on asymmetry in the y-axis electric field and consequently the precursor fault. Thus, the Inventors developed a method and means to apply an AC potential difference across the y-axis electrodes in order to reduce asymmetry in the y-axis electric field and thereby reduce the precursor fault.

The present invention resides in an apparatus and method to improve the filtering action of a quadrupole mass filter by reducing a precursor fault. The invention achieves this technical effect by processing detector data to determine the filtering action of the quadrupole mass filter by checking for a precursor fault and, if a precursor fault is detected, introducing an AC potential difference across the electrode rods in the y-axis to reduce electrical field asymmetry in the y-axis.

The invention enables a QMF to analyze a chemical composition more accurately, overcomes the problems and risks associated with manufacturing a QMF, reduces the precursor fault without having to take evasive action (strip, clean and rebuild the QMF) and allows the QMF to continue to operate at high resolutions.

<u>The Rejection Under § 103 and the Underlying Prior Art References</u>

It is respectfully submitted that the prior art documents cited in the Office Action are not relevant to patentability of the present invention.

U.S. Patent 4,214,160 (FIES et al) discloses a mass spectrometer system and method for controlling the ion energy such that ions of different masses travel with equal velocities through the mass filter without distorting the fringing field produced by the focusing means.

Ion energy is determined by the difference between the potential at which the ion is formed in the ionizing volume and the axis potential of the quadrupole system. This potential difference establishes the velocity of the ions as they travel through the mass filter and it must be small for low mass ions and larger for high mass ions.

Prior art devices have varied the potential difference by applying a sweeping voltage to the ionizing volume (12). However, this creates a distorting effect on the fringing field produced by the focusing means. See lines 26 to 48 of column 1 and lines 19 to 37 of column 3.

The FIES device overcomes the distortion problem by changing the potential difference between the ionizing volume and the mean potential of the electrodes using an ion energy scan voltage. (Note: this is not a potential difference across opposing electrode rods.) The potential difference is created conventionally using a unity gain inverter and a potentiometer – see lines 22 to 32 of column 4. The ion energy scan voltage is connected directly to the X and Y inputs of the electrodes such that the ion energy varies in response to the AC and DC scanning voltages applied to the electrode, which in turn are dependent on the mass of the ions. See lines 1 to 5 and lines 57 to 60 of column 2, lines 45 to 57 of column 4 and the paragraph bridging columns 4 and 5.

Contrary to the Examiner's comments regarding the teachings of this reference, FIES discloses a device and method that is fundamentally different than the present invention. The FIES spectrometer deals with a completely different problem in a very different manner to that of the present invention. FIES never refers to the problem or cause of precursor faults. FIES does not disclose any detecting means that a skilled person may consider suitable for detecting a precursor fault. Furthermore, FIES never indicates an AC potential difference may be applied across the opposing rods in the y-axis; it describes the application of a potential difference across the axis of the spectrometer.

U.S. Patent 5,089,703 (SCHOEN et al) discloses an apparatus and method for overcoming the noise problems associated with an AC (rf) only multipole mass spectrometer.

The improvement in resolution is achieved by superimposing a supplementary AC voltage across a pair of electrodes to generate a supplementary AC field to cause selected ions to resonate, become unstable and be rejected. The supplemental AC voltage may also be frequency or amplitude modulated. See the paragraph bridging columns 14 and 15, and also column 16.

Again, it is clear that SCHOEN does not address the problem or recognize the cause of precursor faults, it does not include processing means to check for a precursor fault, nor is an AC potential difference applied across the y-axis electrodes to reduce asymmetry in the electrical field

Since FIES and SCHOEN do not even remotely disclose numerous claimed features of the present invention, much less address the problem of precursor faults, the combination of these references cannot obviate the present invention. Therefore, the rejection under Section 103 should be withdrawn.

U.S. Patent 6,028,308 (HAGER) discloses a system and method of increasing the sensitivity and the resolution of a mass spectrometer by increasing the kinetic energy of the ions in the fringing field. (Note: this is not related to precursor faults.) This is achieved by altering the AC and DC voltages in the fringing field; specifically by applying an unbalanced AC voltage and a low level DC voltage to the analyzing quadrupole electrode rods Q1.The low level DC voltage may range from 0.1% to 40% of the normal DC voltage. The AC voltage may be unbalanced by applying a different AC voltage to the opposing y-axis electrode rods with respect to the opposing x-axis electrode rods. The AC voltage is preferably 5 to 30% unbalance from 0 to peak or 20 to 60% from peak to peak. Alternatively, the same effect may be achieved by applying a balanced AC and low level DC voltage to the

analyzing quadrupole electrode rods and applying a phased AC voltage to an exit lens. It is therefore also submitted that this reference is not relevant to patentability of the present invention since the reference does not address correction of precursor faults, and fails to disclose the basic claimed elements of the present invention to include any method of applying an AC potential difference across opposing analyzing electrode rods.

Applicant has made a sincere effort to place the application in a condition for allowance; therefore such favorable action is earnestly solicited. In the event that a telephone conversation would further prosecution and/or expedite allowance, the Examiner is invited to contact the undersigned.

Respectfully submitted,

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